Review of Green Job Studies

The table below summarizes several of the most widely cited "green jobs" studies. Following the table is a list of other "green jobs" studies, reports, and articles.

Title of Document	Authors	Scope of Study and Definition of Green Jobs	Green Jobs Strategy	Methodology	Key Assumptions	Findings
Green Recovery; A Program to Create Good Jobs and Start Building a Low-Carbon Economy (September 2008) URL: http://www.americanprogress.org/issues/2008/09/pdf/green_recovery.pdf	AUTHORS: Robert Pollin, Heidi Garrett-Peltier, James Heintz, Helen Scharber SPONSORING ORGANIZATION: Center for American Progress and Department of Economics and Economy Research Institute (PERI) University of Massachusetts-Amherst	GEOGRAPHIC SCOPE: United States TIME FRAME: 2 yrs INDUSTRY SCOPE: Six key infrastructure investment strategies targeting: (1) retrofitting buildings to improve energy efficiency (2) expanding mass transit and freight rail, (3) constructing smart electrical grid transmission systems (4) expanding production of wind power and (5) solar power (6) next-generation biofuels development GREEN JOBS: No specific reference/definition to/of green jobs. Rather, the report projects three sources of job creation related to each infrastructure investment area and identifies 3 types of effects: direct, indirect, and induced EXAMPLE DIRECT EFFECTS: construction and manufacturing jobs to build wind turbines or retrofit buildings EXAMPLE INDIRECT EFFECTS: manufacturing and service jobs created in associated industries that supply intermediate goods for building retrofits or wind turbine manufacturing, such as lumber, steel, and transportation EXAMPLE INDUCED EFFECTS: retail and wholesale jobs created when new workers in construction, manufacturing, and service industries spend their earnings on other products in the economy	$100 BILLION INVESTMENT: combining tax credits and loan guarantees for private businesses with direct public-investment spending: - *$50 billion for tax credits* (would assist private businesses and homeowners in financing commercial and residential building retrofits, as well as investments in renewable-energy systems) - *$46 billion in direct government spending* (would support public building retrofits, the expansion of mass transit, freight rail and smart electrical-grid systems, and new investments in renewable energy) - *$4 billion for federal loan guarantees* (would underwrite private credit that is extended to finance building retrofits and investments in renewable energy)	INPUT-OUTPUT MODELS: - Employment effects are estimated in terms of a given amount of money spent within each industry (e.g., $1 million spent on solar power vs. $1 million spent on oil). - constructed synthetic "industries" by combining components of industries that are now included in the U.S. government surveys and accounts (b/c U.S.gov. surveys and accounts used to construct input-output tables do not specifically recognize wind, solar, biomass, building retrofits, or new mass transit as separate industries) - use national and state-specific input-output models to estimate the effects on employment resulting from an increase in final demand for products of a given industry - employment estimates based on the given amount of money spent within each industry	- $100 billion could be delivered relatively quickly by federal government to state and local governments - Initiative could be paid for with proceeds from auctions of carbon permits under a greenhouse gas cap-and-trade program - assume that the induced employment effect of the green economic recovery program will add one-third to the overall level of job creation generated by the direct and indirect effects - loan guarantee program based on: the government paying $4 billion in accruals on the contingent liabilities from the loan guarantee program; the default rate on these loans is 2%; the guarantee on these loans covers 75% of principal	A short term $100 billion green economic recovery would create 2 million jobs: - Widespread employment gains: across a broad range of familiar occupations (roofers, welders, electricians, truck drivers, accountants, research scientists), strengthen career ladders by providing pathways for workers to move up from lower-paying to higher-paying green jobs that can be created on a geographically equitable basis throughout all regions of the country - Not all areas of the country are equally capable of capturing the benefits of specific technologies, but they are all equally capable of making investments to dramatically improve energy efficiency, expanding mass transit, and increasing efficiency and stability in the electric grid - Roughly triple the number of good jobs - paying at least $16 dollars an hour - as spending the same amount of money within the oil industry - Reduce unemployment rate to 4.4% from 5.7% (calculated within the framework of U.S. labor market conditions in July 2008) - Bolster employment especially in construction and manufacturing (bring back the 800,000 lost jobs- construction employment has fallen from 8 million to 7.2 million jobs over the past two years due to the housing bubble collapse) - Stabilize oil prices by reducing demand for oil which in turn could slow the long-term rise in oil prices
Putting Renewables to	Daniel M. Kammen, Kamal Kapadia,	GEOGRAPHIC SCOPE: United States	Expanding use of renewable energy (wind, geothermal,	- Reviewed methods and conclusions of 13 independent	- RPS is highly simplified, assuming that electricity	- There were two basic types of energy studies used to develop methods and assumptions:

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Work- How Many Jobs Can the Clean Energy Industry Generate (January 2006) URL: http://rael.berkeley.edu/old-site/renewables.jobs.2006.pdf	Matthias Fripp (April 13, 2004; corrected 1/31/06) SPONSORING ORGANIZATION: University of California Berkeley, Energy and Resources group; Goldman School of Public Policy	TIME FRAME: 2002-2020 INDUSTRY SCOPE: Renewable energy (wind, geothermal, solar PV, fuel cells, solar thermal) GREEN JOBS- no direct definition, but refer to employment associated with each energy technology/jobs in renewable energy industry - manufacturing, construction, fuel production and processing (in agriculture for biomass energy), and operations and maintenance (O&M)	biomass, solar PV, fuel cells, solar thermal) through RPS	reports and studies that analyze the economic and employment impacts of the clean energy industry in the U.S. and Europe - Normalized the varying methodologies and assumptions used in each case, and developed a job creation model which shows their implications for employment - Estimated the number of jobs created per average megawatt of power produced - Compared these estimates to similar figures for fossil fuels and then total employment under 5 future scenarios - Modeled five different electricity generation scenarios for 2020 comparing various RPS scenarios to fossil generation scenarios meeting the same electricity needs	production in 2020 is the same as in 2002 - Scenarios do not account for learning effects that may occur in these industries, nor for employment that may result from manufacturing energy equipment for export - See Appendix 2 (on page 21 of the study) for a more detailed discussion of assumptions and sources used in this modeling exercise	input/output models and analytical models (I/O models usually measure indirect jobs created as a result of the clean energy industry while analytical models focus only on direct impacts) - Across a broad range of scenarios, the RE sector generates more jobs per megawatt of power installed, per unit of energy produced, and per dollar of investment than the FF-based energy sector (every technology in the renewable industry generates more jobs in the construction, manufacturing and installation sectors compared to corresponding FF scenarios) - Total employment in RPS scenarios ranges from approximately 163,700-188,000 jobs; employment figures for fossil fuel generation scenarios are 84,000-86,400 jobs. - There is not such a clear distinction between FF and renewable technology in the number of jobs created in O&M and fuel processing. Reliable, low-maintenance wind turbines are estimated to require fewer jobs to operate than are needed to fuel and operate coal and gas plants. However, more jobs are created in O&M of PV systems than in the O&M and fuel processing for coal and gas plants, while biomass plants may create more or fewer jobs in O&M and fuel processing than do coal or gas plants, depending on they way biomass collection is organized (See Table 2) - Supporting the renewable energy industry will benefit sectors of the economy and states that currently suffer from high unemployment (jobs are likely to shift from mining and related services to manufacturing, construction and agriculture [if biomass energy forms a large part of the renewables mix]) - Employment rate in FF-related industries has been declining steadily for reasons that have little to do with environmental regulation (rather, mechanization and mergers lead to continuous layoffs and commodity prices' boom-bust cycles making FF industries and employment in them very volatile); yet a shift from FF to renewables will create some job losses (mining, fossil fuels, and smokestack industries)

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						- Net gain/loss in jobs by 2020: overall for all sectors of the economy = +1,314,000; coal mining = -23,900; oil and gas mining = -61,400; oil refining = -6,300; electric utilities = -35,100; natural gas utilities = -26,200. These losses can be adequately alleviated through a number of policy actions and programs needed to retool and retrain those who stand to lose their jobs in the FF industry
U.S. Metro Economies: Current and Potential Green Jobs in the U.S. Economy (October 2008) URL: http://www.usmayors.org/pressreleases/uploads/GreenJobsReport.pdf	AUTHOR: Global Insight SPONSORING ORGANIZATION; United States Conference of Mayors Climate Protection Center	GEOGRAPHIC SCOPE: U.S. TIME FRAME: 30 years (2008-2038) INDUSTRY SCOPE: Renewable power generation, residential and commercial retrofitting, renewable transportation fuels GREEN JOBS: "any activity that generates electricity using renewables or nuclear fuels, agriculture jobs supplying corn or soy for transportation fuel, manufacturing jobs producing goods used in renewable power generation, equipment dealers and wholesalers specializing in renewable energy or energy-efficiency products, construction and installation of energy and pollution management systems, government administration of environmental programs, and supporting jobs in the engineering, legal, research and consulting fields." (p. 5)	40% RPS (similar in nature to previous federal proposals, but with higher standards and time frame), energy savings target of 35% by 2038, and renewable fuels mandate (30% of gasoline and diesel demand for passenger cars and light trucks to be replaced by alternative fuels).	- Created three separate categories (renewable power generation, retrofitting/weatherizing residential and commercial building, and renewable transportation) - Performed three forecasts of direct jobs under various scenarios: 1) Renewable Power Generation- Total net generation will increase by 30% over 2008 level. RPS of 40% of new total generation in 2038 from renewables (30% wind, 20% solar, 10% incremental hydropower, 10% geothermal, 30% biomass; linear trajectory, resembles paths proposed by 2007/2008 federal legislation) 2) Residential and Commercial Retrofitting- uses coefficients that establish a quantitative relationship between the amount of electricity saved (in millions of kilowatt-hours) and the resulting number of jobs that would be created in the process; uses these coefficients in conjunction with energy savings levels dictated by 35% reduction in energy use to project the number of jobs created when the energy efficiency guidelines are implemented (51% savings in residential sector and 49% allotted to commercial sector) 3) Renewable Transportation Fuels- 30% of gasoline and diesel demand for passenger cars and light trucks is satisfied by alternatives by 2038 (alternatives include corn-based ethanol and biodiesel); rapid	- Shows the growth of new Green Jobs that would occur in metro areas if the current distribution were to remain proportionally unchanged - Forecast results depend heavily on chosen scenarios 1) Renewable Power Generation: scenario construction similar in nature to federal legislation proposed in 2007 and 2008, but with higher RPS and longer timeframe; net generation growth of 30% over 2008 levels; assume 40% electricity generation from alternative sources by 2020 and a distribution among resources within renewable generation 2) Residential and Commercial Retrofitting: reduction in energy consumption of 35% distributed in identical increments each year for 30 yrs (approximately 1.2%/year) 3) Renewable Transportation Fuels: forecast based on the expectation that the private market and legislators will continue to push the U.S. transportation sector toward higher usage of non-petro fuels; assume ethanol and	- Current national count (as of 2006) of 751,000 jobs amounts to less than 0.5% of total current jobs - 85 percent of 2006 green jobs are in metropolitan areas, 15 percent in non-metropolitan counties - Great potential for Green Job growth in regional economies at the metropolitan level - Findings indicate for potential generation of 4.2 million new green jobs across 30 years. This would more than quintuple the total current green jobs count and could provide as much as 10% of new job growth over the next 30 years ** vast majority of Green Jobs are not restricted to any specific location- so great potential for cities and metropolitan areas, or in areas that actively increase their attractiveness relative to competing areas Total of 4.2 million is derived from combining the following: 1) Renewable Power Generation- 1.2 million jobs - trajectory of job growth similar to the assumed path of electricity generation (smooth growth as the manufacturing sector expands to install the new equipment, and more jobs are created for construction and operations and maintenance) 2) Residential and Commercial Retrofitting- 81,000 jobs - 36,000 in the residential sector/ 45,000 in commercial - Would retrofit a small percentage of existing residential and commercial stock of buildings each year and dramatically reduce their energy requirements 3) Alternative Transportation Fuels – 1.5 million; assumes fast growth in early forecast period to reach federal mandate and slower growth thereafter; associated growth in engineering,

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				expansion of production in early portion and slower growth thereafter to reach 30% mark - Projected indirect jobs in the support categories (engineering, legal, research, consulting); 2:1 of direct versus indirect jobs - Combined the results of direct and indirect jobs - Overall U.S. level forecast then distributed to metropolitan areas according to existing shares of Green Jobs, based on current inventory	biodiesel increase their contribution to transportation fuels to 30%. Includes consideration of federal requirement of 36 billion gallons by 2022.	legal, research and consulting positions
Green Collar Jobs in the U.S. and Colorado: Economic Drivers for the 21st Century (December 2008) URL: http://www.ases.org/greenjobs	AUTHORS: Roger H. Bezdek (Management Information Services, Inc.) SPONSORING ORGANIZATION: American Solar Energy Society	GEOGRAPHIC SCOPE: United States with in-depth analysis of Colorado TIME FRAME: 2006 to 2030 INDUSTRY SCOPE: The study assesses the direct job creation in renewable energy (RE) and energy efficiency (EE) industries as well as the indirect job creation in all other sectors of the economy. GREEN JOBS: Direct job creation estimates include employees working in one of the major RE technologies (e.g. wind and solar power) and employees working in industries that are entirely in the EE sector as well as a fraction of employees working in industries partially involved in EE. EXAMPLE DIRECT EFFECTS: Direct job creation in the RE industry includes employees working the wind, solar, hydroelectric, geothermal, biomass, fuel cell, and hydrogen technology industries. Direct job creation in the EE sector includes employees working for industries that fall entirely in energy efficiency such recycling / reuse / remanufacturing as well as a portion	- Study assesses the job creation impacts of moderate and aggressive policies to promote RE and EE. Policy options to promote these sectors include: R&D, tax incentives, RPS mandates, and externalities pricing (e.g. cap and trade).	Study defined three scenarios for future growth of RE and EE: 1) Base Case: this scenario is a continuation of current polices and growth trends similar to the projection from the Energy Information Administration's Annual Energy Outlook 2008 2) Moderate Scenario: assumes incremental policies are enacted to promote RE and EE with projections for industry growth informed by mid-range estimates from other studies (e.g. from EPRI) 3) Advanced Scenario: assumes favorable market conditions and sustained policy commitments to achieve high levels of contribution to U.S. energy from RE and EE; characterized as a "crash" scenario that "pushes the envelope" on what is possible from current and impending RE and EE technologies	- Differ for each scenario; see scenario descriptions under "methodology"	- The vast majority of the jobs created by RE and EE are standard jobs for accountants, engineers, computer analysts, clerks, factory workers, truck drivers, mechanics, etc., and many of the persons employed in these jobs may not even realize that they owe their livelihood to RE and EE. - In 2007, RE was estimated to be responsible for roughly 500,000 jobs (slightly more than half of those jobs are indirect jobs). Over 70 percent of the jobs were in the biomass sector (mainly ethanol and biomass power). - Excluding hydropower and biomass (the largest and most mature segments), the renewable energy sector grew by 15 percent from 2006 to 2007 (more than seven times as fast as the overall U.S. economy). - In 2007, the EE industry was responsible for roughly 8.5 million jobs with about 3.7 million of those being direct jobs. Over 36 percent of the jobs were in the recycling / reuse / remanufacturing industry. - The study estimated the total jobs in 2030 related to the RE and EE sectors under three scenarios: 4) Base Case o RE: 1.3 million o EE: 15 million 5) Moderate Scenario

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		of workers in industries that are partially in the energy efficiency sector, such as household appliances, HVAC systems, vehicle production, and construction. EXAMPLE INDIRECT EFFECTS: This study includes indirect jobs created by the RE and EE such as restaurant staff or dry cleaners employed due to demand from directly created "green jobs."		- Study concedes that while the RE industry is fairly well defined, the EE industry is much more nebulous and difficult to define. - Author estimated fractions of certain industries (e.g. automobile manufacturing, construction) that should be assigned to the EE sector. - Job creation estimates include both private sector jobs as well as relevant jobs in the public and non-profit sectors.		o RE: 2.8 million o EE: 16.7 million 6) Advanced Scenario o RE: 7.3 million o EE: 29.9 million - The study estimated that an aggressive promotion of RE and EE could lead to nearly six times as many jobs in 2030 as the "business-as-usual" scenario.
The Clean Energy Economy: Repowering Jobs, Businesses, and Investments Across America (June 2009) URL: http://www.pewcenteronthestates.org/uploadedFiles/Clean_Economy_Report_Web.pdf	AUTHORS/SPONSORING ORGANIZATION: The Pew Charitable Trusts/Pew Center on the States, in partnership with Collaborative Economics Inc.	GEOGRAPHIC SCOPE: United States INDUSTRY SCOPE: Clean energy, energy efficiency, environmentally friendly production, conservation and pollution mitigation, training and support. GREEN JOBS: "A clean energy economy generates jobs, businesses and investments while expanding clean energy production, increasing energy efficiency, reducing greenhouse gas emissions, waste and pollution, and conserving water and other natural resources."	Develop an inventory of existing businesses and jobs in the U.S. clean energy economy, using a strict definition of a green job and examining only the supply side of the clean energy economy (not including companies on the "demand side" using green products and services).	- Developed a definition of clean energy economy, including five broad categories covering 16 economic sectors - Counted jobs, companies, patent registrations, and venture capital investments in U.S. clean energy economy (as defined) and broke down measurements of each on a state-by-state basis - Identified companies receiving clean technology venture capital, then used the National Establishment Time Series (NETS) to identify similar and related companies. This approach allowed researchers to capture different sets of activities that result in similar products and services. The time frame for analysis was from 1998-2007. - Collaborative Economics Inc. created a new database to track business in clean energy economy, and working with NETS, found clean energy companies across nation. Validity of data was manually checked by analysts to make sure companies were still active and operating according to Pew's definition.	- Analysis is conservative because it counts fairly narrowly defined jobs and businesses rather than entire occupations (e.g., all mass transit workers) and focuses only on the suppliers and producers in a clean energy economy, not jobs associated with the use of those products and services - Does not include jobs associated with nuclear energy, corn-based ethanol - Includes water and other resource management workers	- In 2007, there were approximately 770,385 clean energy jobs, across 68,203 businesses. Between 1998 and 2007, clean energy jobs grew by 9.1 percent, compared to overall jobs growth of 3.7 percent. - Clean energy jobs and businesses exist in every state o Three states have large and fast-growing clean energy economies: Colorado, Oregon, and Tennessee o 12 states have large and growing clean energy economies o Four states have large clean energy economies that are losing jobs o 15 states and DC have small, fast-growing clean energy economies o 12 states have small, growing clean energy economies o Four states had small, shrinking clean energy economies o Of 18 states with both renewable and efficiency standards in place, 11 had more jobs in clean energy economy than the national average - Venture capital investment in clean technology was over $1 billion in 2005, and VC investment totaled about $12.6 billion over the last three years (2006-2008). In 2008, clean energy venture capital investments accounted for 15 percent of global venture capital investment (up from 9 percent in 2007). - Annual incomes of clean energy economy

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						workers range from $21,000-$111,000 - Of five industry categories examined, conservation and pollution mitigation accounts for 65 percent of today's clean energy economy. Three other categories (clean energy, energy efficiency, and environmentally friendly production) are growing at a faster pace, with jobs in environmentally friendly production having grown 67 percent between 1998 and 2007. o The solar industry accounted for 62.5 percent of all clean energy generation jobs in 2007, and the wind industry accounted for 9.7 percent. However, job growth in the wind industry was greater from 1998-2007 than it was for the solar industry. - From 1999-2008, 8,384 clean energy technology patents were filed in the U.S.
Energy Efficiency in the *American Clean Energy and Security Act of 2009*: Impacts of Current Provisions and Opportunities to Enhance the Legislation URL: http://www.aceee.org/pubs/e096.htm	AUTHORS: Rachel Gold, Laura Furrey, Steven Nadel, John "Skip" Laitner, and R. Neal Elliot SPONSORING ORGANIZATION: American Council for an Energy-Efficient Economy (ACEEE)	- Study provides an assessment of the energy savings, net consumer savings, net jobs created, and CO_2 reductions that would be achieved by the energy efficiency provisions included in the American Clean Energy and Security (ACES) Act of 2009, as passed by the U.S. House of Representatives. It then suggests certain changes to these energy efficiency provisions, and estimates the additional benefits these changes might yield. GEOGRAPHIC SCOPE: United States (both national and state level) - No formal definition of "green job" provided; however, much of the net job creation calculated by the analysis occurs as a result of utility investment in efficiency measures as well as investments in building retrofits and transportation efficiency.	- Modify certain energy efficiency provisions in the ACES Act to create additional jobs and achieve greater energy savings and other benefits. These revisions include the following: o Modify the bill's current combined efficiency and renewable electricity standard, instead including a stand-alone renewables standard and a stand-alone energy efficiency resource standard (EERS) requiring 10 percent cumulative energy savings by 2020. o Require that one third of the emission allowances granted to local distribution companies (LDCs) under the bill be directed to energy efficiency purposes. o Sustain the allocation	- Used a modeling tool to assess energy savings, net consumer costs, and emissions savings relative to the Energy Information Administration's (EIA) 2009 Annual Energy Outlook. These measures were modeled for each individual provision at a national level in 2020 and 2030. - The model aggregated the impacts from the bill's energy efficiency provisions to estimate economic savings and jobs numbers for the bill overall, using a four-sector algorithm - Following calculation of national-level energy savings and jobs created through the bill, net consumer jobs and savings were estimated for each state using state-specific energy price and consumption data. - Aggregate job creation estimates were calculated using an input-output framework, taking account of negative job impacts due to decreased revenues for affected sectors, as well as future labor productivity gains.	- Proposed stand-alone EERS would be exclusive of building codes and appliance standards, and would also not include interstate trading of energy efficiency savings. - One billion dollars of the additional funding provided for SEED funds would go towards transportation planning, and the remainder would fund building retrofits. - Algorithm used in modeling analyzes some electricity sector impacts, but does not adjust energy prices based upon reduced consumption achieved through energy efficiency - Due to nature of analysis, results may overstate savings in states already promoting energy efficiency and understate savings in states that have not (modeling algorithm does	- Compared to business-as-usual forecasts, in 2030, current energy efficiency provisions in the ACES Act as passed by the House of Representatives would: o Result in net annual consumer savings of $486 per household o Create more than 600,000 net new jobs o Reduce national energy consumption by 8 percent o Reduce CO_2 emissions by more than 500 million metric tons o Avoid the need for 419 300 MW coal plants - The study also concludes that strengthening the energy efficiency provisions in ACES (as detailed in the Green Jobs Strategy column) could significantly expand these benefits. The study finds that making the recommended changes to the bill would: o Result in net annual consumer savings of $832 per household o Create more than 1 million net new jobs o Reduce national energy consumption by 14.5 percent (compared to the EIA's forecast) o Reduce CO_2 emissions by more than 900 MMT o Avoid the need for 512 300 MW coal plants

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			of allowance value to State Energy and Environmental Development (SEED) funds established in the bill. The bill currently provides 9.5 percent of allowance value to SEED funds from 2012 to 2016, when the allocation begins to ramp down; this study proposes sustaining this 9.5 percent allocation through 2030.		not account for state policies outside of existing state-level EERS, such as building codes) - Assumes that energy efficiency measures come at a levelized cost of 3 cents per kWh for electricity measures, and 30 cents per therm for natural gas measures. Also assumes such measures have a 13 year average lifespan, and that utilities pay one third of program costs while customers pay two thirds. Detailed assumptions are available in Appendix D of the study.	

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